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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

June 28, 1995

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

RE: Ex Parte Presentation
CC Docket No. 92-297

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's rules and regulations, Motorola, Inc. hereby reports that an ex parte presentation was made on June 27, 1995 by representatives of Motorola to Thomas Tycz, Harry Ng, Donna Bethea and Karl Kensinger of the International Bureau. The attached materials formed the basis for the discussions. An original and one copy of this letter and attachment are being submitted for inclusion in this docket.

Respectfully submitted,

Barry Lambergman
Manager, Satellite Regulatory Affairs

cc: Thomas Tycz
Harry Ng
Donna Bethea
Karl Kensinger

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Government Relations
1350 I Street, N.W., Suite 400, Washington, DC 20005-3305 (202) 371-6900 FAX (202) 842-3578

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Satellite Communications Division

FCC Briefing
27 June 1995

PRESENTATION TO THE FEDERAL COMMUNICATIONS COMMISSION

HUGHES SPACEWAY AND IRIDIUM® SHARING ISSUES

By

MOTOROLA SATELLITE COMMUNICATIONS , INC.

JUNE 27, 1995

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PRESENTATION OUTLINE

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- REVIEW OF THE STATUS OF THE IRIDIUM SYSTEM .
- COMMENTS ON THE HUGHES SHARING PROPOSAL
  - GENERAL
  - SATELLITE DIVERSITY
  - SITE DIVERSITY
  - PATH DIVERSITY
- IMPACT SUMMARY ON THE IRIDIUM SYSTEM
- ALTERNATE PROPOSALS
- RECOMMENDATIONS

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SPACE SEGMENT SCHEDULE

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• SV CONSTRUCTION BEGINS	1993
• TWO QUAL MODELS COMPLETED	1995
• FIRST FLIGHT MODEL COMPLETED	1995
• FIRST LAUNCH	1996
• IRIDIUM BEGINS OPERATIONS	1998

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GROUND SEGMENT SCHEDULE

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- SCS OPERATIONAL
  - CHANDLER 1995
  - YELLOWKNIFE 1995
  - HAWAII 1996
  - IQALUIT 1996
  - ICELAND 1996
- PHOENIX GATEWAY
  - ACQUIRE LAND & PREPARE SITE 1995
  - OBTAIN LICENSE 1996
  - CONSTRUCT 1996
  - FULLY OPERATIONAL 1997

BACKGROUND

- ON JUNE 7, HUGHES MADE A PRESENTATION TO THE FCC ASSERTING:
  - THAT IRIDIUM CAN OPERATE CO-FREQUENCY WITH THE HUGHES SPACEWAY SYSTEM WITH MITIGATION.
  - THAT SHARING IS ONLY FEASIBLE IF IRIDIUM WOULD ADOPT MITIGATION TECHNIQUES (SPACE, SITE AND PATH DIVERSITY)
  - THAT THE IRIDIUM SYSTEM HAS THE CAPABILITY TO IMPLEMENT SUCH MITIGATION TECHNIQUES.
- HUGHES ALSO PROPOSED A RULE THAT EFFECTIVELY WOULD PROVIDE IRIDIUM SECONDARY STATUS RELATIVE TO THE HUGHES SPACEWAY AND OTHER GSO SYSTEMS.

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GENERAL COMMENTS

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- THE HUGHES PROPOSAL FOR CO-FREQUENCY OPERATION OF THE SPACEWAY AND IRIDIUM SYSTEM IS BOTH TECHNICALLY INCORRECT AND UNREALISTIC WHEN APPLIED TO THE IRIDIUM SYSTEM.
- NO SHARING SCENARIO BETWEEN THE IRIDIUM SYSTEM AND THE HUGHES SPACEWAY SYSTEM HAS BEEN FOUND TO WORK (THIS ISSUE HAS HAD EXTENSIVE DISCUSSIONS IN THE WRC IWG 4 MEETINGS).
- THE HUGHES FOOTNOTE WOULD RELEGATE NGSO/MSS FEEDERLINKS TO A STATUS WORSE THAN PRESENTLY PROVIDED BY RR2613.
- THE CAPABILITY FOR IMPLEMENTING THE PROPOSED DIVERSITY TECHNIQUES ARE NOT AND CANNOT BE ACCOMMODATED IN THE DESIGN OF THE IRIDIUM SYSTEM.

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GENERAL COMMENTS

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- WE AGREE WITH HUGHES THAT MUTUAL INTERFERENCE IS EXCESSIVE FOR CO-FREQUENCY OPERATION OF THE SPACEWAY AND IRIDIUM SYSTEMS.
- THE INTERFERENCE EFFECTS ARE GREATER THAN HUGHES HAS CLAIMED.
  - HUGHES HAS FAILED TO TAKE INTO ACCOUNT THE CUMULATIVE EFFECT OF BOTH UPLINK AND DOWNLINK INTERFERENCE FROM MULTIPLE GSO SYSTEMS INTO THE IRIDIUM SYSTEM.
- HUGHES ONLY CALCULATED THE SITE DIVERSITY DISTANCE AT THE EQUATOR. AT NON-EQUATORIAL SITES THE AVERAGE DIVERSITY DISTANCE SUBSTANTIALLY INCREASES.

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SATELLITE DIVERSITY

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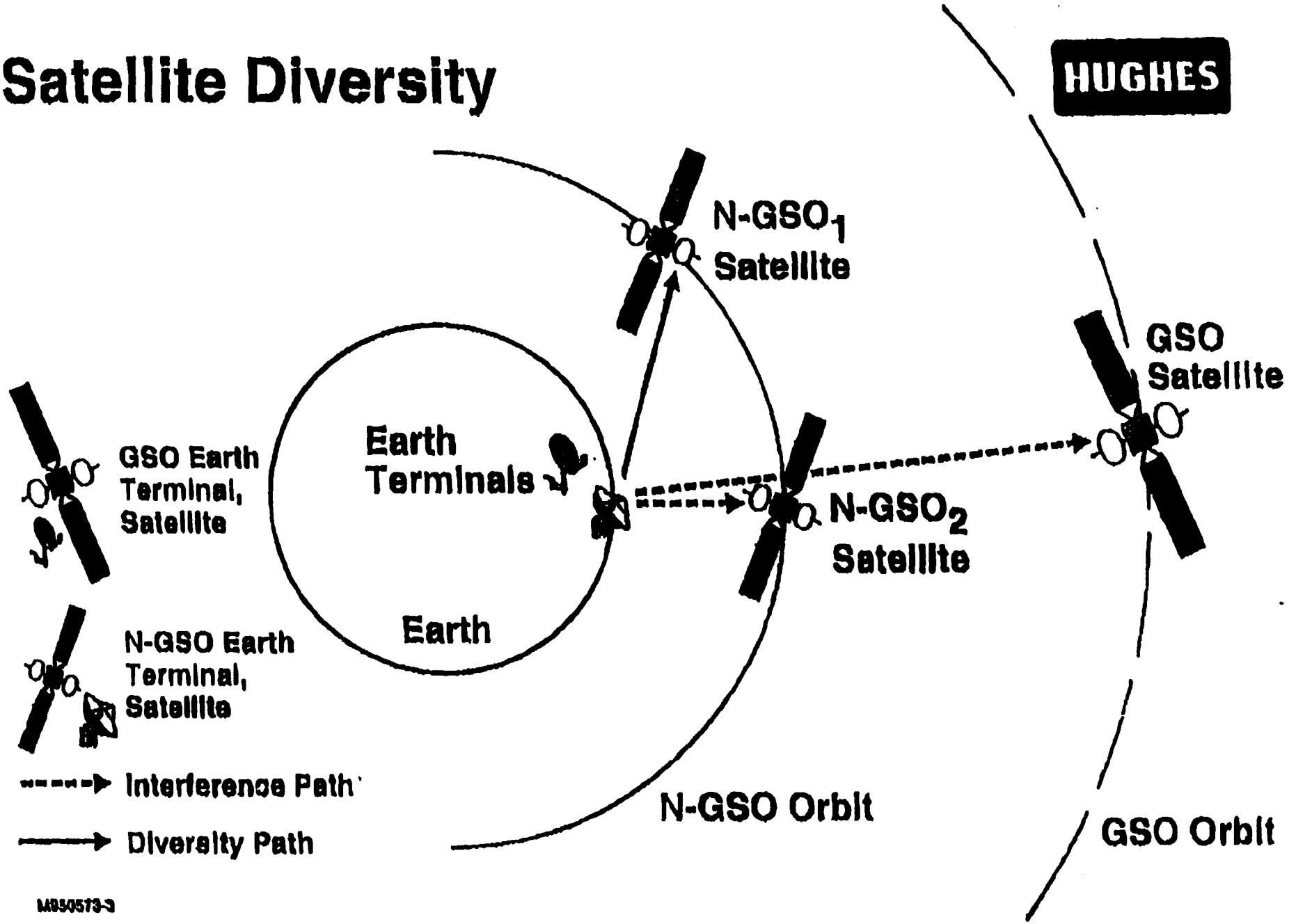
- SATELLITE DIVERSITY CONCEPT: IRIDIUM SHOULD USE AN ALTERNATE SATELLITE WHEN AN IN-LINE INTERFERENCE EVENT OCCURS AND THE HUGHES FOOTNOTE APPLIES
- ASSUMPTIONS:
  - THE BASIC SATELLITE DIVERSITY TECHNIQUE IS EFFECTIVE (A FALSE ASSUMPTION).
  - DURING IN-LINE EVENTS, UNACCEPTABLE MUTUAL INTERFERENCE BETWEEN SPACEWAY AND IRIDIUM WILL OCCUR (HUGHES AND MOTOROLA AGREE ON THIS POINT).

Satellite Diversity

HUGHES



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In-Line Event Geometry

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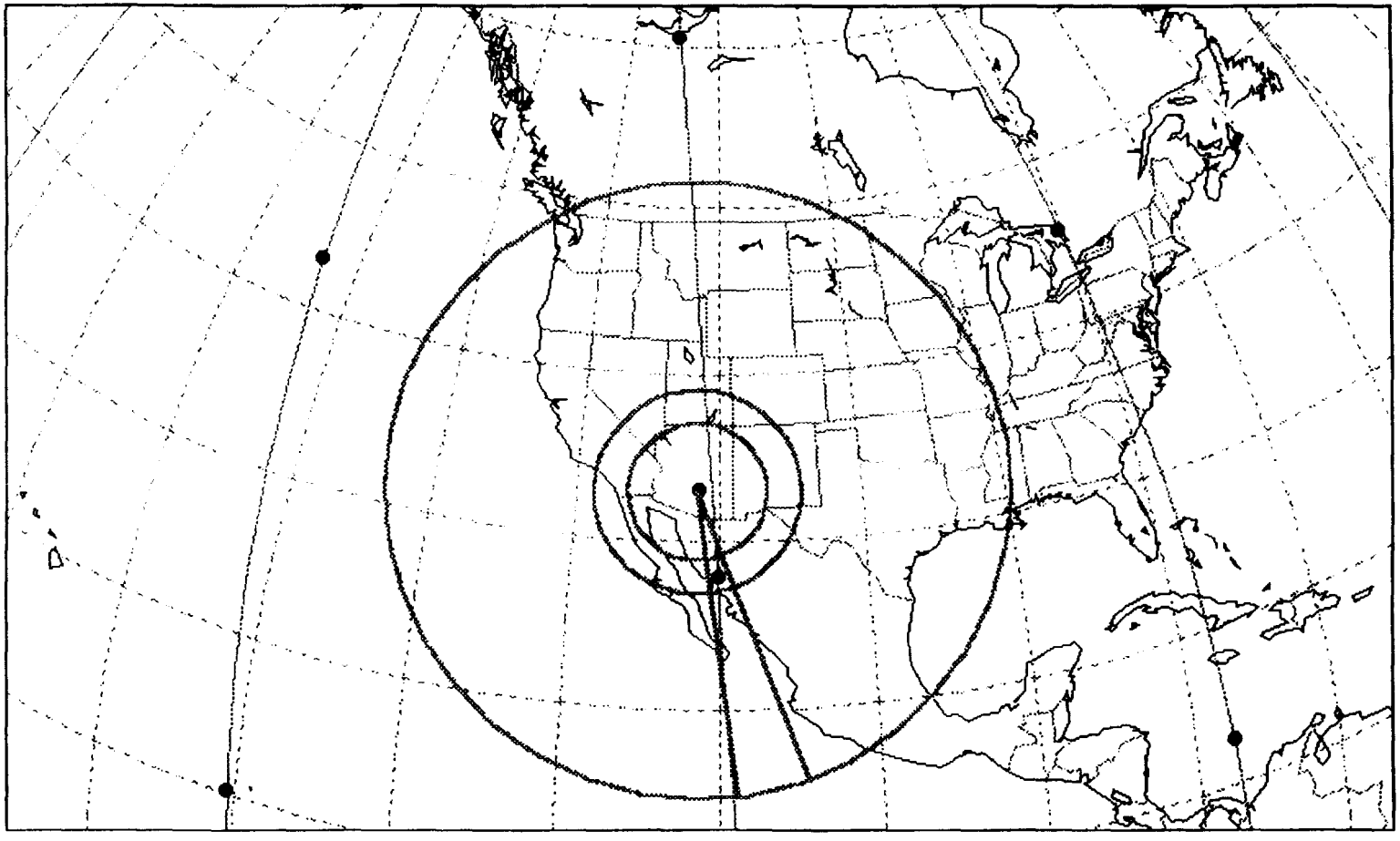
Normal Plane Spacing -- When in interference ring a second satellite is not visible



Dots are satellites
Vertical solid lines are satellite tracks
Center dot is Phoenix Arizona Gateway

Outer Circle = 10 deg. el. angle (min. comm. angle)
Middle Circle = 44 deg.
Inner Circle = 56 deg

Interference occurs between 44 and 56 deg. elev. and 154 and 167 deg. azimuth for -99 and -101 Geo satellite locations

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SATELLITE DIVERSITY ASSESSMENT

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- SATELLITE DIVERSITY IS NOT A VIABLE SOLUTION FOR THE IRIDIUM SYSTEM.
  - NO SECOND SATELLITE IS GENERALLY AVAILABLE WHEN THERE IS AN IN-LINE INTERFERENCE EVENT.
  - A CONSIDERABLY DIFFERENT CONSTELLATION WOULD BE REQUIRED.

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SITE DIVERSITY

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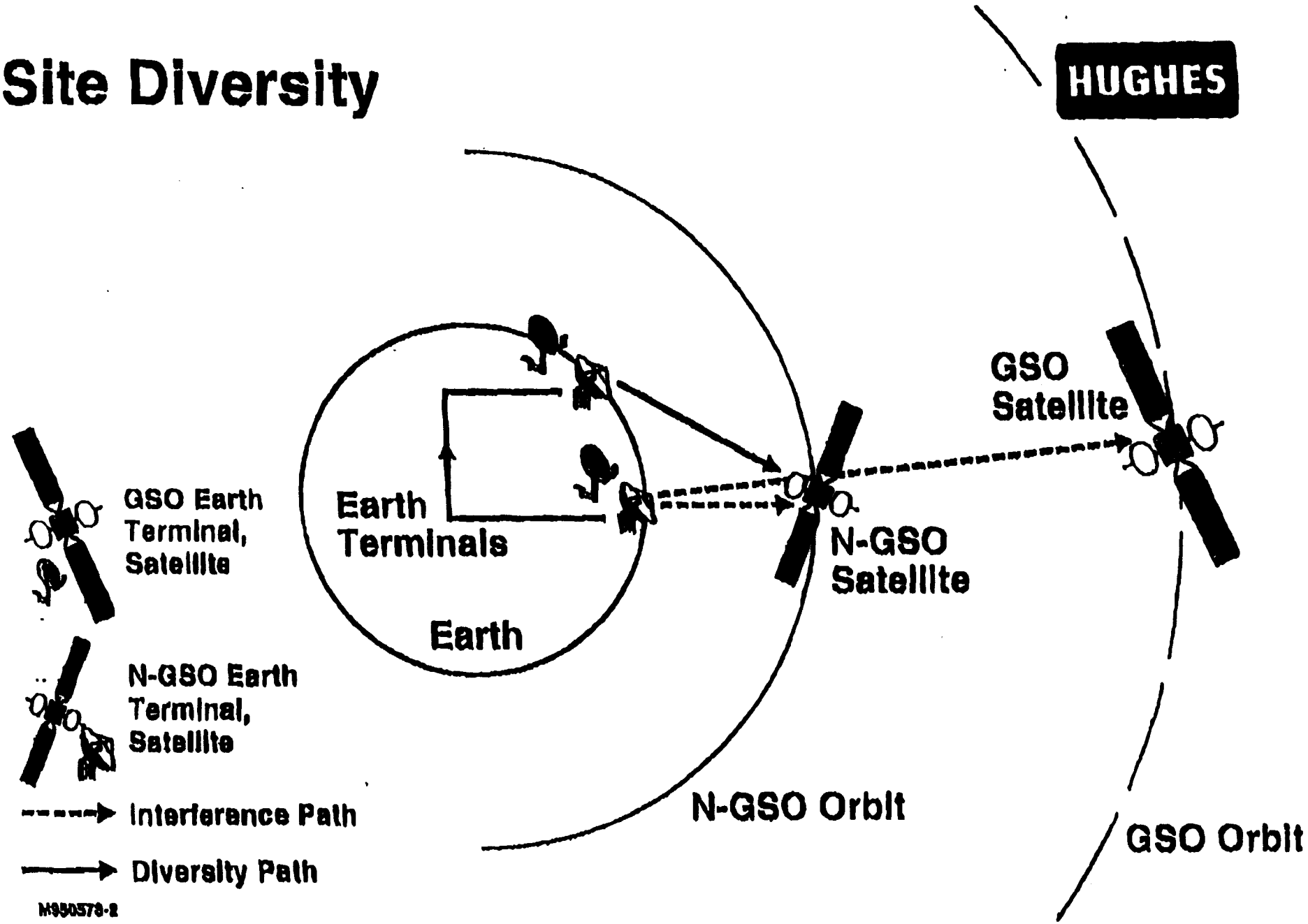
- HUGHES SITE DIVERSITY CONCEPT: IRIDIUM SHOULD IMPLEMENT ITS GATEWAYS WITH WIDELY SEPARATED (up to 276 sm at the equator) DIVERSITY TERMINALS.
- HUGHES ASSUMPTIONS
  - THE BASIC SITE DIVERSITY TECHNIQUE IS EFFECTIVE (A FALSE ASSUMPTION).
  - THE IRIDIUM SYSTEM ARCHITECTURE AND HARDWARE CAN SUPPORT THIS (A FALSE ASSUMPTION).

Site Diversity

HUGHES



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GATEWAY ARCHITECTURAL DESIGN

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- EACH GATEWAY REQUIRES 3 OR 4 EARTH TERMINALS (ET)
- ALL GATEWAY EARTH TERMINAL SITES ARE WITHIN A 25 sm DIAMETER CIRCLE SO AS TO BE WITHIN THE 1 dB BEAMWIDTH OF THE SATELLITE ANTENNA (INCLUDING POINTING TOLERANCES).
- THE GATEWAY HAND-OFF BETWEEN SATELLITES MUST BE "MAKE BEFORE BREAK".
- CAPABLE OF TWO CARRIER OPERATION (UP TO 960 CHANNELS/CARRIER).

SATELLITE ARCHITECTURAL DESIGN

- EACH SATELLITE HAS FOUR HIGH GAIN Ka BAND ANTENNAS FOR COMMUNICATIONS WITH GATEWAYS.
- OPERATIONAL SCENARIO
  - TWO Ka BAND ANTENNAS ARE REQUIRED TO COMMUNICATE WITH THE EARTH TERMINAL CARRYING TRAFFIC.
  - AT LEAST ONE ANTENNA (POSSIBLY TWO) POINTED AT NEXT GATEWAY AND PERFORMING ACQUISITION OR CARRYING TRAFFIC TO THE NEXT GATEWAY.
  - SPACECRAFT ANTENNA SLEW AND ACQUIRE OPERATION REQUIRES APPROXIMATELY 30 SECONDS.

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One SV Servicing Two GW's

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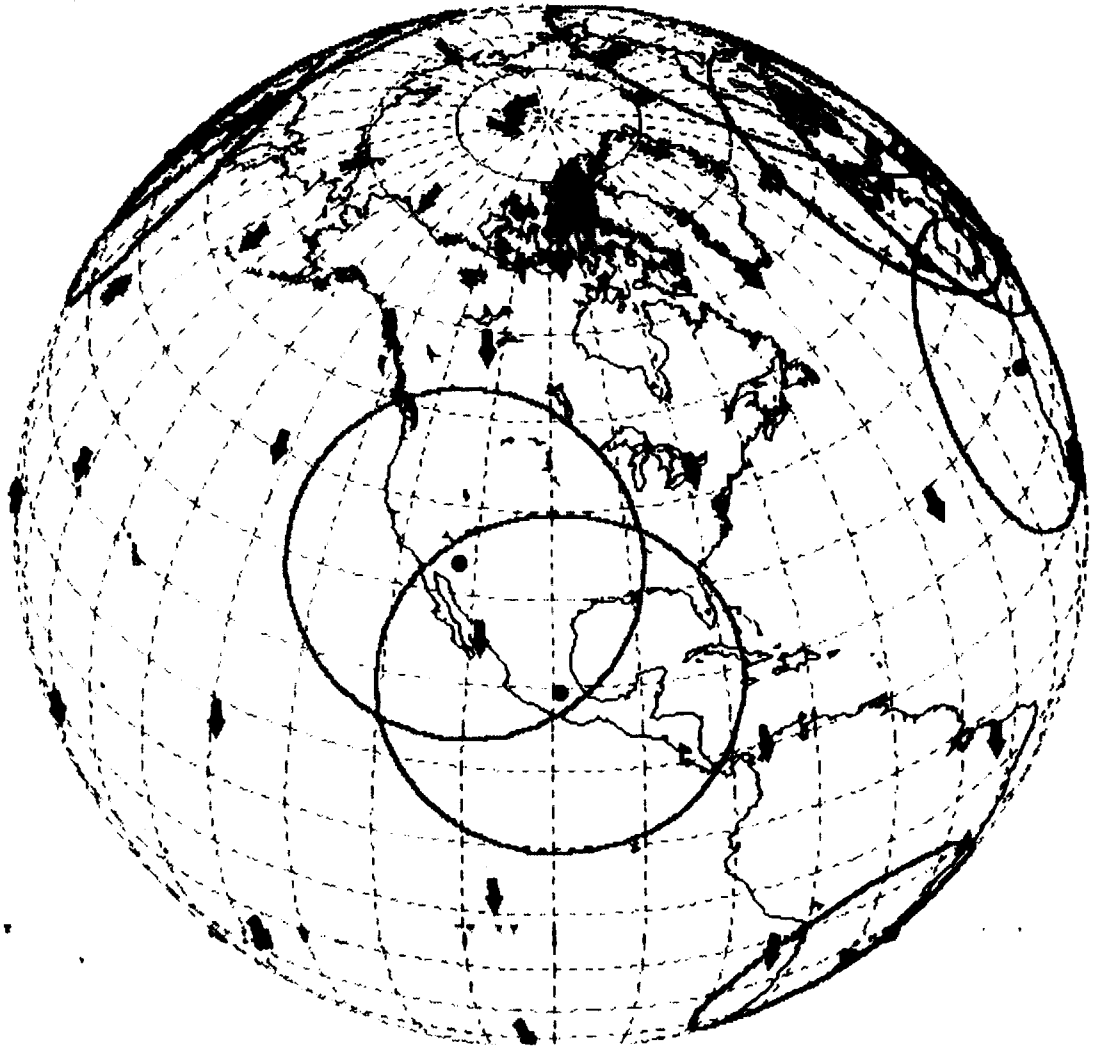
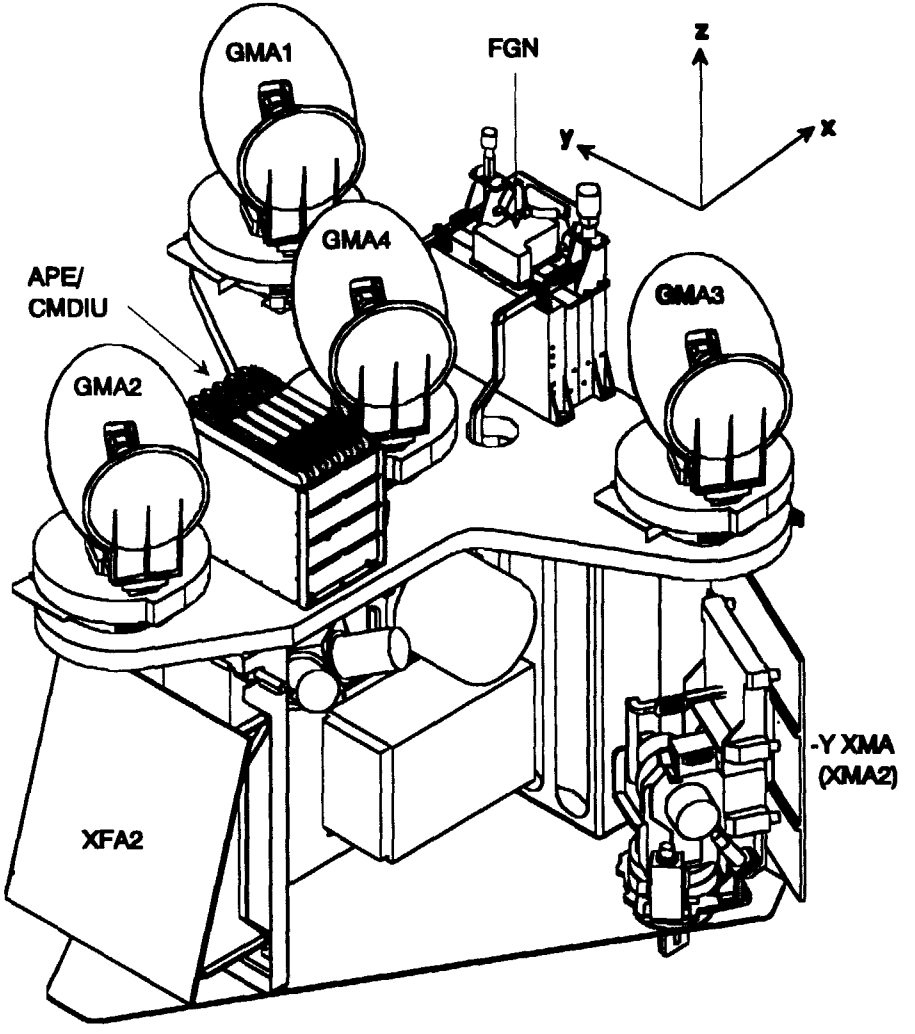


SV Nadir Panel Layout



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SITE DIVERSITY IMPACT ASSESSMENT ON THE SATELLITE

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- UNDER THE HUGHES PROPOSAL, THE DIVERSITY ET'S ARE NO LONGER IN THE BEAMWIDTH OF THE SATELLITE ANTENNA,
  - THE NUMBER OF STEERABLE HIGH GAIN Ka BAND ANTENNAS MUST BE INCREASED GREATER THAN FOUR (EIGHT).
  - SATELLITE CONFIGURATION WILL NOT SUPPORT MORE THAN FOUR Ka BAND ANTENNAS.
- CONSTELLATION DOES NOT SUPPORT WIDELY SEPARATED DIVERSITY ET'S.
  - VISIBILITY STATISTICS ARE NOT SUFFICIENT (WOULD REQUIRE MORE SATELLITES).
- REDESIGN OF THE SATELLITE AND THE CONSTELLATION WILL CAUSE A CATASTROPHIC SCHEDULE IMPACT ON THE IRIDIUM PROGRAM.

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SITE DIVERSITY IMPACT ON THE GATEWAY

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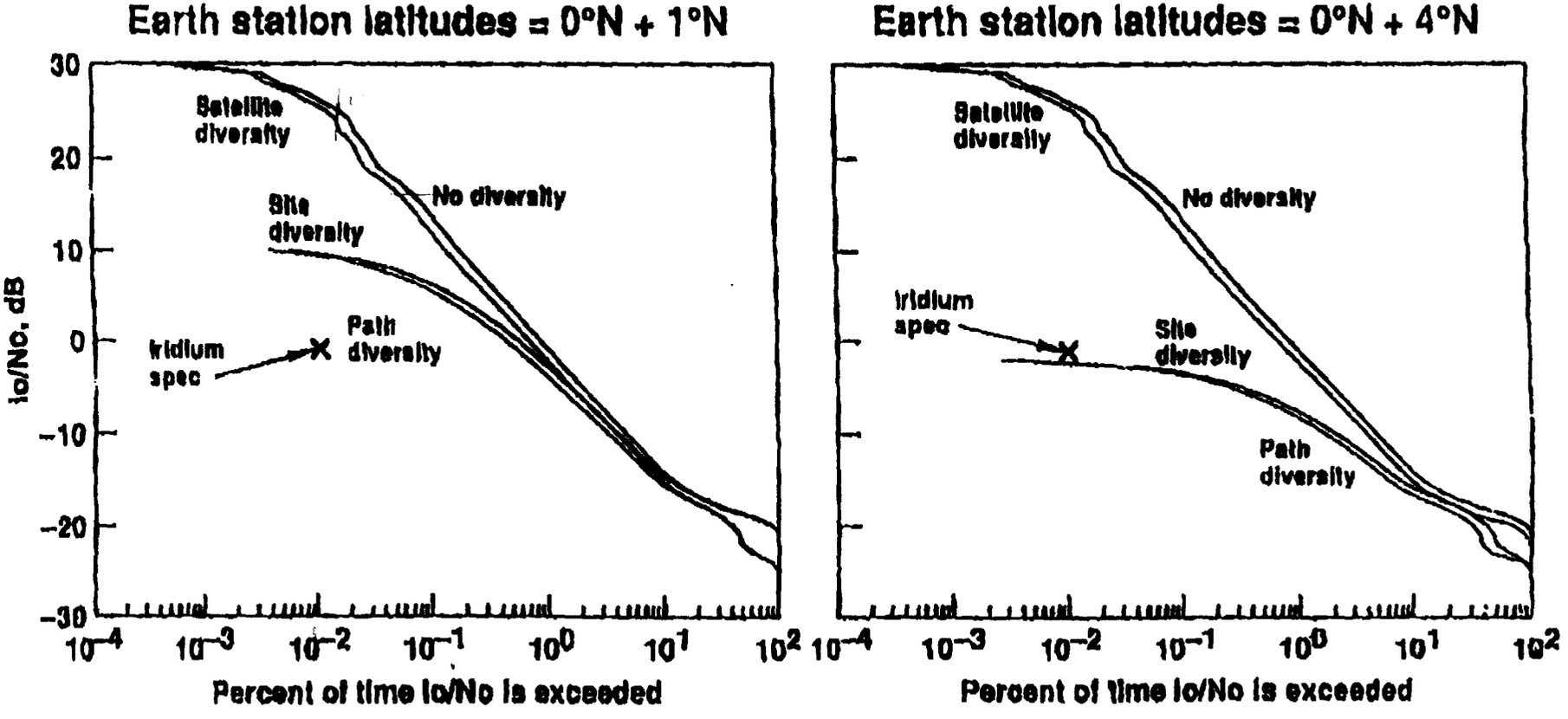
- REQUIRED SPACING OF THE DIVERSITY GATEWAY.
  - HUGHES ANALYSIS SHOWS THAT THE IRIDIUM DIVERSITY GATEWAYS WOULD HAVE TO BE SEPARATED BY 276 sm (4 DEGREES OF LAT/LONG).
  - HUGHES CHART SHOWS THAT THE 276 sm IS DERIVED AT THE EQUATOR.
  - THIS DISTANCE INCREASES SIGNIFICANTLY AS THE LATITUDE INCREASES.

LATITUDE DEG	DIVERSITY DEG	ET SPACING SM
0	4.0	276
35	16.7	1155
45	NOT POSSIBLE	

  - SITE DIVERSITY AT US LATITUDES IS UNREALISTIC.

Spaceway Into Iridium Uplink— 7 GSO Satellites at 2° Spacing

HUGHES



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SITE DIVERSITY IMPACT ON GATEWAY

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- HUGHES PROPOSED MITIGATION TECHNIQUE DRAMATICALLY INCREASES THE NECESSARY GATEWAY HARDWARE.
  - DIVERSITY DOUBLES THE NUMBER OF ET SITES PER GATEWAY AND MORE THAN DOUBLES THE GATEWAY HARDWARE.
- ARCHITECTURAL CHANGE REQUIRED
  - SYSTEM ALLOWS FOR ONLY ONE ROUTING DESTINATION PER GATEWAY.
  - DISTANCE LIMITATION BETWEEN GATEWAY AND THE ET IS 1 MILLISECOND (115 MILES IN CABLE).
  - SIGNIFICANT CHANGES IN HARDWARE ALREADY DESIGNED, AND IN MANY CASES, MANUFACTURED AND DELIVERED.

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DIVERSITY MORE THAN DOUBLES GW HARDWARE

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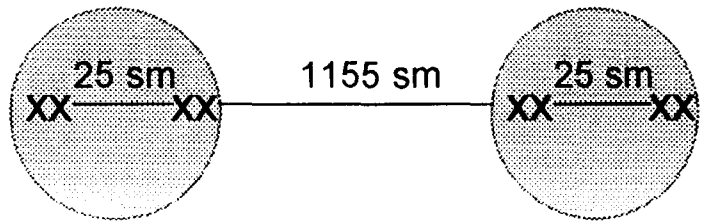
Configuration:



GATEWAY ITEM	NORTH AMERICA		WORLD WIDE	
	As Is	With Site Diversity	As Is	With Site Diversity
Total Gateways	6	6	20	20
Sites	12	24	40	80
Earth Terminals	24	48	80	160
Data Concentrators	-	6	-	20
Remote Comm. Links	6	18	20	60
Remote Link Distance [nm]	150	7230	500	24100

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SITE DIVERSITY IMPACT ON THE GATEWAY

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- SCHEDULE IMPACT DUE TO THE DIVERSITY GATEWAY
  - THE ARCHITECTURAL CHANGES AND HARDWARE IMPACTS WOULD STOP THE PRESENT GATEWAY PROGRAM, HALT CONTRACT NEGOTIATIONS AND FORCE MOTOROLA INTO A GATEWAY REDESIGN.
  - THE RESULT WOULD BE DELAYING THE OPERATIONAL DATE FOR THE SYSTEM WELL BEYOND 1998.

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SITE DIVERSITY IMPACT ON THE GATEWAY

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- COORDINATION IMPLICATIONS
  - INTERNATIONAL
    - OTHER COUNTRIES WILL FOLLOW FCC DECISION.
    - SOME COUNTRIES ARE NOT LARGE ENOUGH TO SUPPORT SITE DIVERSITY.
      - JAPAN, TAIWAN, ITALY, KOREA
  - IMPACT ON LMDS
    - NEGOTIATED A SPECIFIC NUMBER OF SITES.
    - NUMBER WOULD HAVE TO INCREASE SUBSTANTIALLY.
    - NULLIFIES THE BASIS FOR SHARING WITH LMDS.